

# Formulae for A-level Mathematics

**AS Mathematics (7356)**

**A-level Mathematics (7357)**

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For the new specifications for first teaching from September 2017.

This booklet of formulae is required for all AS and A-level Mathematics exams.

There is a larger booklet of formulae and statistical tables for all AS and A-level Further Mathematics exams.

Further copies of this booklet are available from:  
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**Pure mathematics****Binomial series**

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n \quad (n \in \mathbb{N})$$

$$\text{where } \binom{n}{r} = {}^n C_r = \frac{n!}{r!(n-r)!}$$

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{1.2} x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{1.2\dots r} x^r + \dots \quad (|x| < 1, n \in \mathbb{Q})$$

**Arithmetic series**

$$S_n = \frac{1}{2} n(a + l) = \frac{1}{2} n[2a + (n-1)d]$$

**Geometric series**

$$S_n = \frac{a(1-r^n)}{1-r}$$

$$S_\infty = \frac{a}{1-r} \quad \text{for } |r| < 1$$

**Trigonometry: small angles**

For small angle  $\theta$ , measured in radians:

$$\sin \theta \approx \theta$$

$$\cos \theta \approx 1 - \frac{\theta^2}{2}$$

$$\tan \theta \approx \theta$$

**Trigonometric identities**

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B} \quad (A \pm B \neq (k + \frac{1}{2})\pi)$$

## Differentiation

$f(x)$	$f'(x)$
$\tan x$	$\sec^2 x$
$\operatorname{cosec} x$	$-\operatorname{cosec} x \cot x$
$\sec x$	$\sec x \tan x$
$\cot x$	$-\operatorname{cosec}^2 x$
$\frac{f(x)}{g(x)}$	$\frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$

## Differentiation from first principles

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

## Integration

$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

$$\int \frac{f'(x)}{f(x)} dx = \ln |f(x)| + c$$

$f(x)$	$\int f(x) dx$
$\tan x$	$\ln  \sec x  + c$
$\cot x$	$\ln  \sin x  + c$

## Numerical solution of equations

The Newton-Raphson iteration for solving  $f(x) = 0$ :  $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$

## Numerical integration

The trapezium rule:  $\int_a^b y dx \approx \frac{1}{2} h \{(y_0 + y_n) + 2(y_1 + y_2 + \dots + y_{n-1})\}$ , where  $h = \frac{b-a}{n}$

## Mechanics

### Constant acceleration

$$s = ut + \frac{1}{2}at^2 \quad \mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$$

$$s = vt - \frac{1}{2}at^2 \quad \mathbf{s} = \mathbf{v}t - \frac{1}{2}\mathbf{a}t^2$$

$$v = u + at \quad \mathbf{v} = \mathbf{u} + \mathbf{a}t$$

$$s = \frac{1}{2}(u + v)t \quad \mathbf{s} = \frac{1}{2}(\mathbf{u} + \mathbf{v})t$$

$$v^2 = u^2 + 2as$$

## Probability and statistics

### Probability

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \cap B) = P(A) \times P(B|A)$$

### Standard deviation

$$\sqrt{\frac{\sum(x - \bar{x})^2}{n}} = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$$

### Discrete distributions

Distribution of $X$	$P(X = x)$	Mean	Variance
Binomial $B(n, p)$	$\binom{n}{x} p^x (1 - p)^{n-x}$	$np$	$np(1 - p)$

### Sampling distributions

For a random sample of  $n$  observations from  $N(\mu, \sigma^2)$ :

$$\frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \sim N(0, 1)$$

### End of formulae



